l. Spare. The designated specialized activity is the lowest maintenance level authorized by the maintenance plan to return the item to a serviceable condition from all failure modes and/or to direct disposition of an unserviceable item.

APPENDIX B

Technical Replacement Factors (TRFs)

During the provisioning process for a new system/equipment, each part within the system/equipment subject to wear out and replacement that is not identified to a National Stock Number (NSN) shall be assigned a TRF by the contractor. The TRF is an engineering estimate derived from several sources, depending upon the characteristics of the item (electrical, mechanical, electronic). The TRF is used in the computation of stocking levels until the item has been in the system long enough to establish a demand or usage pattern. When demand data are applied, the TRF is updated.

1. Relationship of TRF to Failure Rate. Failure rate, as commonly used in discussing reliability or failure prediction of equipment and their repeat parts, is the ratio of the number of part failures divided by the population of the part and the time period over which failures were observed. Failure rates are commonly expressed in terms of the number of failures per million hours of operation, although conversion can be made to ant time base convenient for discussion.

The similarities between TRF and failure rate are readily apparent; they both represent a ratio of the number of occurrences of an event (failure to usage) to the population of the item in service during the time the event occurred; they both are used to predict the number of events expected to occur during some future time period; they both are subject to bias due to faulty classification (e.g., an item was replaced even though it had not failed).

The TRF assigned to an item is not only a function of failure, but is also a function of maintenance philosophy which determines what is to be replaced (demanded).

2. TRFs of Zero. There is a rationale for an item to have a TRF of zero. For example;

- It is never demanded, because it never fails

- It is never demanded, because when it fails, it is not replaced, since the individual parts within, which have caused it to fail, are replaced (i.e., the item is repaired).

In each of the above, the single condition which causes an item to have a TRF of zero is that it is never demanded. There is but one reason for an item to have a zero failure rate; it never fails.

3. Example of TRF Calculation. TRF is calculated by applying the appropriate data to the ratio of item replacement times the hours per year divided by item population. The TRF is an eight position numeric entry in the LSAR "H1" record, Card 11, Block 9 (MRRI block). The decimal point is assumed to fall between the fourth and fifth positions. It is reported in Card C Block 34 of the LSA-036 Report.

The procedures for calculating the TRF of a table lamp are presented in this section. The lamp consists essentially of 4 parts:

- The light bulb - a consumable assembly
- The combined socket and switch - a consumable assembly
- The electric cord - a consumable item
- The plug - a consumable item

The assumption is made that the lamp is operated for 1,000 hours a year, or a little less than 3 hours a day, and that the functional parts of the lamp listed above have the following Mean Time Between Failures (MTBFs) and failure rates:

Item	MTBF	Failure Rate/Year
Light Bulb	750 HRS	1.333
Socket Switch	10,000 HRS	0.100
Electric Cord	15,000 HRS	0.066
Plug	10,000 HRS	0.100

By summing the failure rates of the parts of the lamp, the failure rate of the lamp itself can be derived. Doing this, it is found that the lamp will fail 1.599 times per year, largely due to the light bulb failing 1.333 times per year. But the other parts will make some contribution to the failure rate of the lamp. The table above does indicate, however, that if the lamp is owned for a long period of time, say 10 or more years, failure of the socket/switch, cord or plug is to be expected. Note at this point that even though the failure rates of the parts of the lamp have been determined, the TRFs of the parts or the lamp cannot be determined. To do this, the maintenance philosophy for the lamp needs to be known. In this simplified case, the number of different maintenance philosophies available are few: the lamp may either be repaired when it fails, replaced when it fails, or a combination of the two. That is, the lamp might be repaired when it fails if the light bulb is the failed part, and replaced when any of the other parts have failed. Note that the TRFs to be assigned to the lamp and the parts are a function of which of the above is chosen. If the lamp is replaced any time it fails, the lamp is the replaced (demanded) part; therefore, it has a TRF, but none of the parts do. If the lamp is repaired by replacing the failed parts, each of these has a TRF; the lamp does not. If the light bulb is replaced when it burns out, but the whole lamp is replaced when anything else fails, the lamp and the light bulb have TRFs, but the other parts do not. The maintenance philosophies and the resultant variable TRFs can be shown in a table thus:

Item	Failure Rate Per Year	Replace Failed Part	Replace Lamp	Replace Failed Bulb, Otherwise Replace Lamp
Lamp	1.599	TRF = 0	TRF = 1.599	TRF = 0.266
Bulb	1.333	TRF = 1.333	TRF = 0	TRF = 1.333
Socket/Switch	0.100	TRF = 0.100	TRF = 0	TRF = 0
Cord	0.066	TRF = 0.066	TRF = 0	TRF = 0
Plug	0.100	TRF = 0.100	TRF = 0	TRF = 0

Using the simplified example above, some parallels can be drawn between this example and the maintenance philosophies experienced in supporting shipboard equipment.

The first maintenance philosophy represents the "traditional" way a majority of equipment is supported today; i.e., repair in place using piece parts throughout the life of the equipment, with replacement of the end item only in the event of catastrophic failure or damage beyond repair.

The second philosophy represents the case of modular replacement with no repair at the organizational level. In the case of Navy equipment, the module, or in our example the lamp, might be sent to a depot for repair and returned to the owner or to stock.

The third philosophy represents limited organizational maintenance, with more difficult and time consuming repair deferred to a higher level.

The sample serves to illustrate that assignment of a TRF requires knowledge of failure rates for the parts concerned. TRF is also a function of the maintenance philosophy to be applied. That is, the determination must be made whether the item will be replaced (demanded) upon failure, for is an item will not be replaced (demanded) upon failure, its TRF must be zero. Since TRF equals demand divided by population, if demand is zero TRF is also zero.

4. TRFs Assigned to Consumables. TRFs for low cost, common design consumables (resistors, capacitors, etc.) shall be taken from the Generic Item Name Technical Replacement Factor Guide (provided as Government Furnished Information). This data reflects observed supply demand for these items, including false replacements, requisitions for stores, tool boxes, losses, etc., in addition to actual failures. For high cost, unique design consumables peculiar to the end item (special purpose tolls, power supplies, potted or encapsulated assemblies), use the following sources in descending order of preference:

a. Actual failure data from the manufacturer.

b. MIL-HANDBOOK-217 Reliability Prediction converted to TRF by multiplying failures per 100 hours by yearly component operating hours, taking duty cycles and stress factors into consideration.

c. Observe data for similar items.

5. Repairable Item TRFs. TRFs for repairable items are first assigned a raw TRF as described in paragraph 4 above. The raw TRF is then derated by a derating factor described below.

a. Items Totally Repairable at the Organizational Level. Obtain the appropriate TRF as described in paragraph 4 and then apply a derating factor from .10 to .99 depending upon the ease of repair, cost of the item and availability of all components of the assembly at the organizational level. The resulting replacement factor will be the number of items per application per year which fail, are not repaired at the organizational level, and must be requisitioned from the storeroom.

b. Items Installed by the Intermediate Level and Totally Repairable at the Intermediate Level. Obtain the appropriate TRF as described in paragraph 4 and then apply a derating factor from .10 to .99 depending upon ease of repair, cost of the item and availability of all components of the assembly at the intermediate level. The resulting replacement factor will be the number of items per application per year which fail, are not repaired at the intermediate level, and must be requisitioned from the storeroom.

c. Items Partially Repairable at the Organizational Level and Totally Repairable at the Intermediate Level. Obtain the appropriate TRF as described in paragraph 4 and then apply a derating factor from .10 to .99 depending upon ease of repair, cost of the item and availability of all components of the assembly at the organizational level. The resulting replacement factor will be the number of items per application per year which are neither repaired at the organizational level nor the intermediate level, and which must be replaced from system stocks.

d. Items Not Repairable at the Organizational or Intermediate Level and Partially or Completely Repairable at the Depot Level. Enter the appropriate TRF as described in paragraph 4 to the organizational level. A derating factor will be assigned based on carcass survivability.

APPENDIX C

Guidance For Assignment Of Part To Component MECs

The Military Essentiality Code (MEC) indicates the degree to which unavailability of a replacement for an installed item when needed to perform corrective maintenance affects the ability of the end item to perform its primary function. An end item is a final combination of end products, component parts, and/or materials which is ready for its intended use, e.g., radar set, electrical generator, etc. The need to perform corrective maintenance is normally the result of failure of an item, and so essentially is commonly evaluated in the context of item failure. But it must be remembered that some parts may be needed for replacement due to their use when replacing other failed parts (e.g., gaskets). The MEC is a single position numeric entry in the LSAR "H1" record, Card 12, Block 6 (EC block). The MEC is reported in Card A Block 11 of the LSA-036 report.

I. CODE 1

A. MIL-STD-1388-2A Definition: Failure of this item will render the end item inoperable.

B. Guidance on Assignment of:

1. Failure of this item in its normal failure modes will result in total and catastrophic failure of the end item or a critical function of the end item.

2. This item is a part which normally is not considered to fail but is required to be installed, along with an item whose failure will result in total and catastrophic failure of the end item (e.g., gaskets, seals: etc.).

3. This item monitors a critical function and a malfunction will not allow an operator's capability to recognize a catastrophic failure.

II. CODE 3

A. MIL-STD-1399-2A Definition: Failure of this part will not render the end item inoperable.

B. Guidance on Assignment of:

1. Failure of this item in its normal failure modes will result in at most minor degradation of the end item.

III. CODE 5

A. MIL-STD-1388-2A Definition: Item does not qualify for assignment of Code 1, but is needed for personnel safety.

B. Guidance on Assignment of:

1. The Navy states that for MEC Code 5, the item may or may not qualify for assignment of Code 1; however, failure without immediate replacement of lack of this item will directly and immediately infringe on the safety of personnel operating or maintaining the equipment. This code should not be assigned to parts or assemblies which are installed in systems whose primary purpose is safety of ship/aircraft or personnel simply because of that system relationship unless the item separately meets the first part of this guidance.

2. If an item qualifies for MEC 5, it should be assigned MEC 5 regardless of what other MEC it also qualifies for.

IV. CODE 7

A. MIL-STD-1388-2A Definition: Item does not qualify for the assignment of Code 1 but is needed to prevent impairment or the temporary reduction of operational effectiveness of the end item.

B. Guidance on Assignment of:

1. Failure of this item in any of its normal failure modes will not result in total and catastrophic failure of the end item but rather will result in only partial degradation of the end item allowing continued operation within acceptable performance ranges. Items should be classified as MEC 7 if their normal failure modes are gradual deterioration or wear and such gradual deterioration or wear is noticeable or detectable prior to its reaching maximum limits. Items should also be classified as MEC 7 if redundancy provides for continued operation after failure of one unit of an item but at reduced capacity or capability. If redundancy provides for continued operation after failure of one unit of an item at normal capacity or capability, assignment of MEC 3 is appropriate.

2. This assignment applies to all built-in test circuitry which is critical to the monitoring or fault isolation of the end item. The exception applies to those components which monitor critical functions in which a failure will hide a critical failure.

APPENDIX D

Reference Designation

The purpose of the Reference Designation Example is to illustrate the relationship between the following data elements:

- Reference Designation
- Quantity per Assembly (QTY/ASSY)
- Quantity per End Item (QTY/EI)
- Part Number

REFERENCE DESIGNATION STRUCTURE:

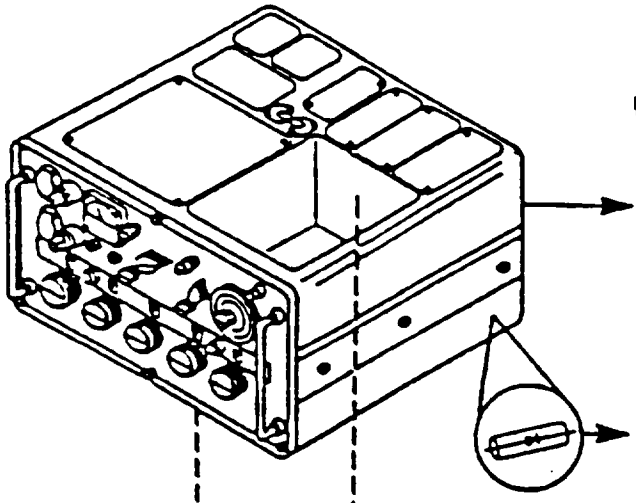
A reference designation provides configuration information linking a part to a location within an equipment. The preferred reference designation structure is the standard ANSI Y32.16 electronics format (i.e. 1A2C-5). Other acceptable formats are the technical manual format figure and index number (i.e. FIG-12 ITEM-38) or the engineering drawing and item number (i.e. DRAWING 39847-4 ITEM 25). The provisioning activity can provide additional guidance regarding acceptable reference designation formats.

The receiver appearing on the next page illustrates the relationship of an equipment (e.g. the receiver) to some of its components and parts. The receiver and its subordinate components are all identified by a unique reference designation. Each additional level of indenture of breakdown adds additional characters to the Reference Designation, moving from the receiver (Reference Designation "1") to the diode (Reference Designation "1A2A6A15CR-4"). The following "family tree" and reference designation example describe these relationships:

LINE ITEM	REFERENCE DESIGNATION	QTY ASSY	QTY EI	PART NUMBER
RECEIVER	1	1	1	01A2266000-21-11
RADIO-SUBASSY	1A2	1	1	01A2266062-21-11
DIODE	1A2CR-1	1	4	JAN IN649
XLATOR-SYN	1A2A6	1	1	99A226060-21-11
CIRCUIT CARD	1A2A6A15	1	2	01A226078-21-11
DIODE	1A2A6A15CR-4	2	REF	JAN 1N649

(See Reference Designation Example on Page D-2)

REFERENCE DESIGNATION EXAMPLE



LISTINGS

REFERENCE DESIGNATION	QTY ASSY	QTY EI	NOMENCLATURE	PART NUMBER
1	1	1	RECEIVER	01A2266000-21-11
1A2	1	1	RADIO-SUBASSY	01A226062-21-11
1A2CR-1	1	4	DIODE	JAN 1N649
1A2A6	1	1	XLATOR-SYN	99A226060-21-11
1A2A6A15	1	2	CIRCUIT CARD	01A226078-21-11
1A2A6A15CR-4	2	REF	DIODE	JAN 1N649
1A2A8	1	1	POWER SUPPLY	01A266170-21-11
1A2A8R-2	1	1	RESISTOR	RCR07G105JS
1A2A8CR-1	1	REF	DIODE	JAN 1N649

QTY/ASSY AND QTY/EI RELATIONSHIPS:

The sum of all QTY/ASSY values for a given part in the equipment must equal the QTY/EI of the part. This may lead to a computational problem when an assembly is used several times in an equipment but its component parts are listed only once at the first appearance of the assembly.

To resolve the problem, the QTY/ASSY of each component is adjusted by multiplying the original QTY/ASSY by the QTY/EI of the assembly. In the "receiver" example, the original QTY/ASSY of the 1A2A6A15CR-4 diode (i.e. "1") is multiplied by the QTY/EI of the 1A2A6A15 assembly (i.e. "2") and the resulting QTY/ASSY for the diode is "2".

An automated summation of the QTY/ASSY values for the diode, part number JAN IN649, now results in a correct QTY/EI value of "4".

REFERENCE DESIGNATION, QTY/ASSY AND QTY/EI RULES:

The following "rules" will help ensure that proper Reference Designation, Quantity per Assembly and Quantity per End Item are provided in provisioning technical documentation:

- Each Reference Designation must be unique.
- Reference Designation structure must provide an automated sort in top-down sequence. (See the ICAPS User's Guide or on-line help facility for guidance.)
- Reference Designation must agree with technical manuals and drawings.
- Quantity per End Item must indicate the total quantity within the "equipment". *
- A summation of the Quantity per Assembly for a part within an "equipment" * must be equal to the QTY/EI for the part.

* The term "equipment" refers to any item being documented by a unique Provisioning Contract Control Number (PCCN).

APPENDIX E

Indenture Coding

The purpose of the Indenture Coding Example is to illustrate the relationships between the following data elements;

- Indenture Code
- Quantity Per Assembly (QTY/ASSY)
- Quantity Per End Item (QTY/EI)
- Part Numbers

INDENTURE CODING STRUCTURE

A | B | C | D | E | F

A End Item
- B Detailed parts of end item not contained in components of installed system

B Component (UNIT)
- C Detailed parts of component (unit) which are not assemblies or subassemblies

C Assemblies
- D Detailed parts of subassemblies which are not subassemblies

D SUBASSEMBLIES
- E Detailed parts of subassemblies which are not sub-subassemblies

E SUB_SUBASSEMBLIES
- F Detailed parts of sub-subassemblies

(See Indenture Coding Example on Page E-2)

The following "family tree" shows the indenture coding structure as depicted in the Indenture Coding Example. Note that the first listed bearing at indenture level "D" shows QTY/ASSY of 1 and a QTY/EI of 2. For the second listed bearing, which has the same part number as the first bearing, the QTY/EI is REF to indicated that this line item has already appeared on the provisioning list.

Line Item	Indenture Code	QTY/ASSY	QTY/EI	Part Number
PUMP	B	1	1	ABC
CASING	C	1	1	DEF
ROTOR ASSY	C	1	1	GHI
IMPELLER	D	1	1	JKL
SHAFT	D	1	1	MNO
BEARING	D	1	2	PQR
BEARING	D	1	REF	PQR